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Farmer attitudes to injurious pecking in laying hens and to potential control strategies

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Running title: Attitudes to injurious pecking

Abstract

Farmers' recognition of health and welfare problems, and their responses to related intervention programmes such as those to reduce injurious pecking (IP) in hens, directly influence the welfare of animals in their care. Changing those responses can be achieved through a re-positioning of social drivers as well as from individual behaviour. This study begins by considering how certain levels of plumage damage become normalised while others might be considered unacceptable. Drawing upon in-depth farmer interviews, the study investigates how management practices for addressing the issue of IP are developed and enacted, looking at the relative

influence of intrinsic and extrinsic individual behavioural factors. Twelve farmers with varied uptake of evidence-based management strategies designed to reduce levels of IP were interviewed. Although farmers ranked images of flocks with various levels of plumage damage in a similar order to scientists, their perception of levels of IP in their own flocks varied, and was not consistently associated with the actual levels measured. Most farmers recognised both financial and welfare implications of IP and expressed pride in having a good-looking flock. The popular management strategies were those designed to redirect pecking to other objects, whereas a substantial barrier to uptake was the perception of creating other problems: for example mislaid eggs if early access to litter and range were adopted. To achieve uptake of knowledge that improves animal welfare on farm it may be necessary both to shift the norms perceived as acceptable, and to overcome barriers to change that include lack of time and understanding, by providing impartial advice and facilitation of ownership of the issues.

Introduction

The effects of injurious pecking (IP) by one bird on another are recognised as significant welfare and economic issues, in laying hen flocks. Not only can the recipient bird suffer considerable physical damage, which is painful and can lead to death from heat loss, disease or cannibalism, but IP can have a wider effect upon the entire flock, raising stress levels and the susceptibility for disease.[1] IP is associated with lower egg production levels at around 30 weeks (Huber-Eicher & Sebö 2001), partly explained by increased mortality, as victims of IP die sooner (Yngvesson *et al* 2004) thus producing fewer eggs over their lifetime with clear economic consequences. It is a widespread concern within the poultry sector as there is evidence of it occurring in all housing systems and across different bird ages (Bestman *et al* 2009). Between 50-90% of free range and organic flocks show evidence of IP (Bestman *et al* 2009; Lambton *et al* 2010), while in 100

[1] In this paper we use the term injurious pecking (IP) to include gentle and severe feather pecking, cannibalistic pecking and vent pecking (Lambton *et al* 2013). IP does not include aggressive behaviour, which is usually directed at the head, as it is thought to be a form of redirected foraging behaviour and may indicate that the environment is not meeting the behavioural needs of the hens (Weeks & Nicol 2006).

commercial UK free-range flocks monitored by Lambton *et al* (2013), the mean prevalence of severe pecking behaviour varied from 55% at 20 weeks, to 83% at 40 weeks of age.

In most commercial systems, the impact of IP is managed by routine beak trimming, although this does not necessarily reduce the performance of all IP behaviours (Pötzsch *et al* 2001; Lambton *et al* 2010) as it does not address the causal factors underlying IP. Beak trimming is a welfare concern (FAWC 2007) as it is a potentially painful mutilation that in principle should be avoided (Council directive 199/74/EC). In line with this, the UK government has scheduled the current derogation that permits beak trimming to terminate at the end of 2015 (House of Commons Library 2012). However, to ensure that hen welfare is not compromised, it needs to be possible to effectively manage IP by other means (FAWC 2009). The negative welfare consequences of uncontrolled IP would be greater than those caused by routine beak trimming. Consequently, there is a pressing need to identify other effective methods for controlling IP on commercial farms (Lambton *et al* 2013).

The shift from the routine physical intervention of beak trimming to practical flock management solutions raises two particular challenges. First, those responsible for flock health and welfare must be able to recognise and assess the relative levels and prevalence of IP in order to take appropriate action. Moreover, such assessments should be normalised, that is to say broadly comparable across different farms and systems if management solutions are to be coherently effective. Second, farmers faced with a range of possible management strategies need to be able to make confident and informed choices about which strategies to adopt.

There is a growing body of scientific literature identifying housing conditions, litter quality, and diet (reviewed by Nicol *et al* 2013; Rodenburg *et al* 2013) as primary risk factors for IP amongst flocks. Consequently it has become clear that management actions are, especially in the absence of beak trimming, increasingly important in reducing IP. Here, the factors that influence farmers in their understanding of the issue and in the selection of their management strategies (what we might term secondary risk factors, Whay

78 2007) become equally critical. Drawing upon qualitative social science methodologies, this paper first
79 explores farmer perception and recognition of different levels of plumage damage amongst laying-hen flocks
80 and, second, examines how their own attitudes to and understanding of IP and its causes impact upon the
81 choice of management strategies they adopt to address the issue.
82
83 In the study of which this paper is a part, Lambton *et al* (2013) developed a range of 46 management
84 strategies which were used in 100 commercial free range (i.e. with daytime access to pasture) flocks most of
85 which were beak-trimmed. They found that the more strategies deployed the greater the protective effect
86 against severe feather pecking and plumage damage. Nonetheless, a mean of 84.1% birds per flock still
87 displayed some degree of plumage damage at 40 weeks. Despite having one to one support and
88 encouragement to adopt extra strategies relevant for each flock in 53 'treatment' flocks, on average only about
89 half of the 46 strategies were employed on any one farm. Thus it appears that further research is needed to
90 identify the causal factors for IP and develop more effective means (including genetic) of reducing the risks in
91 commercial flocks, as farmers remain generally reluctant to adopt additional management strategies to reduce
92 IP.
93
94 Farmers' attitudes towards health and welfare problems and related intervention programmes, such as those to
95 reduce IP, have become an important area of recent research (Boivin *et al* 2003; Kauppinen *et al* 2010;
96 Kielland *et al* 2010). A greater understanding of farmer attitudes is widely held as a necessary prerequisite for
97 the subsequent understanding of farmer behaviour, itself a critical prerequisite for promoting behavioural
98 change to achieve improved levels of farm animal welfare (Whay 2007). Specific methodologies have been
99 developed to understand and predict farmer attitudes and behaviour in general, originally with respect to
100 innovation adoption, but more recently with respect to engagement in pro-environmental and pro-welfare
101 behaviour and practices (Escobar & Buller, 2014). Although much of this has been wrapped up into forms of
102 predictive behavioural modelling (for example, Ajzen 1991; Ajzen 1998; Ellis-Iversen *et al* 2010),
103 understanding the social and individual drivers for attitudinal and behavioural change has become an
104 important component in our understanding of how evidence-based knowledge and experimental experience

105 can be enrolled into practical and durable changes in livestock management. Contemporary behavioural
106 research acknowledges that rational economic calculation sits alongside a multitude of other considerations in
107 the determination of behaviours and practices. Drawing in part on the language of the Theory of Planned
108 Behaviour (Ajzen 1991), these might include intrinsic factors, such as perception of social norms, peer
109 pressure, attitudes towards the sources, forms and flows of information, assessments of personal capacity and
110 agency, past experience, values and others (Vaarst *et al* 2002) as well as the more extrinsic factors relating to
111 access to informational, economic and social resources. Collectively, these increasingly numerous and
112 complex elements become recognised as actual or potential determinants of individual behaviour and
113 therefore key sites for addressing the possibility of behavioural change and to achieve desired policy
114 outcomes.
115
116 Researchers in the social sciences have more recently suggested that the routine performance of social
117 practices (which include system design, material arrangements, social relations, sector rules and
118 knowledge flows) plays a much larger role in determining actions than the focus on individual attitudes,
119 values and beliefs might imply (Hargreaves 2011). Hence a growing emphasis is being placed on how such
120 practices develop, are normalised and are reinforced through unchallenged repetition. Change, if it is to be
121 sought and achieved, derives from a re-positioning and development of those practices rather than solely from
122 individual behaviour. With this in mind, the current study begins by considering how certain levels of IP
123 become normalised while others might be considered unacceptable. Drawing upon farmer interviews, the
124 study investigates how management practices for addressing the issue of IP are developed and enacted,
125 looking at the relative influence of intrinsic and extrinsic individual behavioural factors. The paper addresses
126 the need for more information on barriers to uptake of knowledge on farm by interviewing a proportion of the
127 farmers involved in the study described by Lambton *et al* (2013).
128

129 ## Materials and Methods
130
131 The study reported here was conceived as an adjunct to the research by Lambton *et al* (2013), the aim of
132 which was first to identify practical evidence-based 'management strategies' to control IP and second to

monitor the cumulative effectiveness of these strategies when implemented in 100 commercial flocks of laying hens kept in free-range housing systems. As part of this process, 53 so-called 'treatment' flocks were provided with bespoke advice and encouraged to adopt more management strategies. Levels of uptake were then monitored alongside the impact on their flock performance and welfare (levels of plumage damage, IP behaviour, production, mortality etc.). By way of comparison 47 'control' flocks, for which no advice was given, were merely monitored. All these flocks were kept on 63 farms throughout Great Britain and all were already using a varied number of the management strategies at the start of the study. At the end of the primary study all the farmers received a management booklet including suggested management strategies and research findings and this, together with other sources of evidence-based knowledge now provide farmers with tested information (available from www.featherwel.org). As all had restocked with another flock by the time of interview, they could have read and adopted some of this information, particularly if they had managed a 'control' flock for the main study.

Participants and interviews

In order to select 12 potential participants for interview all the farmers who had participated in the main study (Lambton *et al* 2013) were ordered separately, according to the number of management strategies they had employed (regardless of whether or not the strategies were suggested by the project team), into three categories 'high', 'medium' and 'low' adopters. 'Treatment' and 'control' groups were ordered separately. As treatment flocks generally adopted more management strategies (likely due to suggestions made by the project team), the proportion of the 46 potential strategies used by 'high' adopters was in the range 59-78%; 'medium' and 'low' adopters used 46-58% and 18-45% respectively. For control flocks 39-54% was considered high adoption, 36-39% medium, and 24-35% low adoption.

From all 63 farms, three farmers directly responsible for flock management were randomly selected for face-to-face interview from each of the 'high', 'medium' and 'low' levels of management strategy adoption for treatment flocks and one farmer for each level from control flocks (summary data are shown in Table 1). Of the 12 farmers selected for interview, three had run organic flocks of which one had intact beak birds: the second intact beak flock was not organic. The farmers also varied in age, experience and gender. Mean flock

size was 7,145 (range 2,808-15,400) with a range of five breeds in those sampled. One of four researchers visited each farm and interviewed the farm owner or stockperson (hereafter referred to as 'the farmer'). The recorded, semi-structured interview was based on a set of open-ended questions that explored the farmer's perception of IP, management strategies, advice and advisors, and issues regarding implementation. These researchers were all involved in drawing up the questionnaire and had discussed together how to carry out the interview with the guidance of experienced Sociologist HB.

The sample of 12 farmers was intentionally small. The aim was to undertake an in-depth study of farmer perception, motivation and action through individual interviewed cases. In line with an earlier study (Horseman et al 2014) no claim is made here that the findings can be generalized to wider population of poultry farmers. A recognised point of data saturation (Morse 1995) was reached in the current study with the emergence of a number of key themes. This is consistent with other studies that have found that the key elements for meta-themes (Bazeley 2009) may emerge from relatively small, yet sufficient numbers of in-depth interviews.

Table 1 about here

Ranking of photos of plumage damage

Drawing on visual research methodologies developed, particularly, in environmental and conservation planning (for example, Manning & Freimund 2004), and adapting them to the current research objective of determining the normalisation of certain levels of IP, a set of nine photographs of flocks of birds, each with different degrees of feather cover, was presented to each farmer in a random order. The farmer was told that flocks were all in the same age range (30-40 weeks) and was asked to order the photographs from best to worst plumage condition; equal ranks were not allowed within the photoset, so no two photographs received the same rank from one farmer. The farmer was also asked to identify the point at which they would consider the level of plumage damage (indicative of IP) to be unacceptable. The research group agreed upon a 'gold

188 standard' for the rank order of the photographs and this gave the photographs an additional label from A (best)
189 to I (worst feather cover) to compare with the farmer rankings. The research group were all experienced in
190 feather scoring on farm using standardised scoring systems such as those used in Lambton et al (2013) or in
191 the LayWel project (Blokhuis et al, 2007), thus there was a systematic basis for the 'gold standard' ranking.
192 Statistical analysis was carried out on the photo rankings using IBM SPSS Statistics 19 (IBM Corp., Armonk,
193 NY). Inter-rater agreement was calculated by computing kappa for all rater-pairs and using the mean of the
194 estimates to provide an overall index of agreement (Hallgren 2012) between farmers. The mean kappa value
195 was also calculated to compare each farmer ranking with the 'gold standard' commonly agreed upon by the
196 research group. The level of agreement indicated by the kappa values was interpreted as 'poor' (0.00-0.4),
197 'moderate' (0.41-0.60), 'substantial' (0.61-0.80) or 'excellent' (>0.81); these values were based on the
198 benchmarks provided by Landis & Koch (1977) and Fleiss *et al* (2003). The point at which the farmers
199 viewed the plumage damage as unacceptable was qualitatively examined to identify reasons for their decision.
200 This 'tipping point' was analysed in terms of rank position and the first photo with unacceptable plumage
201 damage.

202 ## Interviews

203 Audio recordings of the interviews were manually transcribed. Subsequent themes emerging from the
204 interview transcripts were identified using scrutiny techniques; searching for repetitions within and between
205 interviews and highlighting similarities and differences between texts, as suggested by Ryan & Bernard
206 (2003). A processing technique of 'cutting and sorting' (Ryan & Bernard 2003) was used to group similar
207 themes together and identify the most relevant for analysis. Specifically, each transcript was read and relevant
208 dialogue was highlighted. The highlighted sections were collectively grouped into meta-themes relating to: the
209 perception of IP; attitudes towards management strategies; barriers to management strategy uptake; and
210 knowledge transfer.
211

Results

Normalisation of plumage damage

The results of the photographic survey were available for 8 of the 12 farmers interviewed and reveal what we choose to call a 'moderate' level of agreement between farmers (mean kappa 0.500; total rater-pairs, 28; range 0.125-1.000) and 'substantial' agreement between farmers and the agreed gold standard (mean kappa 0.719; total rater-pairs, 8; range 0.500-1.000) as shown in Table 2 and indicated by the kappa values. For technical reasons the full data were not available for farmers E, F, H and J. Reassuringly, farmers were clearly able to identify the progressively worse levels of plumage damage.

Table 2 about here

Nonetheless, the level at which they would become concerned varied. Data were available for 10 of the 12 farmers interviewed (missing data from K and J). As shown in Table 3, most farmers considered only 3-4 flocks had unacceptable levels of plumage damage, whereas three felt most photographs were unacceptable, drawing the line below 3-4 flocks with good feather cover. The farmers who were more tolerant of plumage damage had flocks of various sizes, with evidence of IP and plumage damage whereas the farmers 'drawing the line' earlier had relatively small flocks (<5000) and two were organic.

Table 3 about here.

Smaller producers are, we would suggest, more sensitive to the occurrence of IP, perhaps because plumage damage is more obvious sooner in a smaller flock, or because the farmers are more aware of individual bird behaviour within smaller flocks. Farmer I, though interviewed based on their organic study flock, also had conventional free range flocks and mentioned concern at different levels of plumage damage depending on the housing system implying that different systems evoke different levels of concern. Organic assurance schemes tend to specify that hens be kept without beak-trimming so it is likely that farmers with intact beak flocks are more aware of IP, since the potential consequences of an outbreak are greater in intact beak flocks.

Perception of Injurious pecking from interview analysis

Qualitative analysis of the interviews showed that farmers expected flocks to show some level of plumage damage by the end of lay; Farmer C maintained that: “just by the nature of all that output, the hens are not going to look perfect at 72 weeks”. One quarter of all interviewed farmers said they would be unconcerned if a small proportion of the flock experienced feather loss, but would consider the same level of plumage damage to be unacceptable if the majority of birds were affected. Moreover, feather loss was sometimes associated with specific breeds: “we did have birds nearly as bad as that… but I reckon it was because they were [Breed X] and they were renowned for losing their feathers” (Farmer G).

Three of the participating farmers (K, G, and B) did not perceive IP to be a problem amongst their flocks. Farmer K's perception was substantiated, since they implemented the third highest number of management strategies by the end of the Lambton et al (2013) study and had the lowest measured IP and plumage damage levels. Farmer G, who found only the worst 3 flocks in the photoset to show unacceptable levels of plumage damage, said "I don't find [IP to be] an important issue, I don't have a problem with pecking" (though researchers found evidence of IP occurring in their flocks). This suggests Farmer G's normative frame of reference allows the presence of IP to be tolerated and accepted. Although Farmer B did not perceive a problem with IP in their current flock, they were aware of the problem in their previous flock (which provided data for Table 1) and had since implemented further measures. As many as half the farmers interviewed considered IP to be only a ‘moderate’ problem despite reporting that they had certainly had recent problems with IP in these beak trimmed flocks of up to 15 thousand birds. That IP is harder to manage in birds with intact beaks was confirmed by two organic farmers (E, who at the time of interview housed organic flocks with intact beaks, and L) who thought IP was an important issue and were currently experiencing IP issues in their flocks "[IP is] definitely one of the most important issues... it's very noticeable... I seem to have struggled with the last few flocks that I've had" (Farmer L).

Seven farmers linked IP to both welfare and financial implications. Farmer L told us: “if I have poor welfare, then I have a poor financial return, so the two are interlinked… the driver is I don’t like seeing birds which are

being picked on… but we're all in here to make money". Between the two areas of concern, four of these deemed welfare to be most important, though a further two identified IP as primarily a financial issue.

The majority (9/12) believed IP to be indicative of problems relating to farm management, environment and the health of the birds. Farmer F argued: "I think that feather cover usually is an indication of the overall health of the bird as much as other measures you are putting in… If they are feeling stressed, because of health issues or management, then that is expressed in feather pecking".

Two thirds of farmers relied on their own judgement to identify an IP problem on their farm and perceived having a well feathered flock as important for reasons of job satisfaction and professional identity, for example, Farmer C maintained: "you've got to work with them every day, so you don't really want a bunch of straggly, horrible looking chickens". This might include pride in having a good-looking flock and the need to give visitors a good impression: "It's just the overall perception of good animal health and husbandry really, for those who come to see the chickens, whether it be customers or other, auditors or whoever" (Farmer F). Ten of our respondent farmers believed the public was essentially ignorant of the issue, and the problem, of IP.

Virtually all of the farmers interviewed accepted some responsibility for IP occurring in their flocks. Farmer B stated: "the old flock… came from exactly the same rearer, they were reared in exactly the same way, they've both been on the same feed, same breed… points to management… I'll have to confess, really." When asked who else should be doing something about IP, two thirds said that breeding companies should be working towards producing birds for free range and organic systems rather than focusing on caged birds. Three farmers wanted more research to be done, especially before the proposed UK ban on beak trimming is enforced and comments like "you can't introduce a ban on this beak tipping… until you have a suitable answer for [IP]" (Farmer C) were frequently made. Two thirds of farmers said it was important to prevent IP from starting at rear, before the pullets reach the laying farm. Three were simply more fatalistic: "I don't think there is

anything anyone can do, it is just down to the flock" (Farmer D), which also suggests a perceived lack of control over the occurrence of IP at a personal level.

Attitudes towards Management Strategies

All of the participant farmers, with a single exception, were keen to take on additional measures to address IP and especially so if IP was perceived as an on-going problem on the farm. A typical example was given by Farmer A: "I would say [I am] broadly keen [to employ measures], because they are generally simple things that one can do to put it right so I'd be very happy to". The only participant not to engage with additional measures was already implementing many strategies and was not keen to do more than he was already doing (Farmer J).

All respondents considered the general management of flocks to be important in controlling IP, such as controlling ventilation, temperature and light intensity in the building; adopting disease control measures and water sanitation; managing litter condition and hens' diet. Farmer C noted that: "There's other fundamentals that you've got to get right before hanging a toy [will improve IP] … If you've got an issue with lighting, or ventilation, then a bit of string or toys aren't going to make any difference really." One third of farmers also believed that spending time around the birds was important in order to notice changes or deal with any problems.

The most popular management strategies were those with numerous benefits and a clear strategic purpose; for example to give birds activities to reduce boredom. Nine of the farmers approved of management strategies aimed at promoting foraging behaviour using what one of them described as 'distraction techniques' such as scattering whole wheat and grit on the litter, or providing objects for birds to peck at such as straw bales, hanging objects and hard blocks to peck at. Farmer D stated: "I think the best [management strategies] were getting them out early and some good litter, because if they are busy on the litter then they are not feather pecking, they are busy doing something else". Three quarters of our respondents were also keen to implement measures designed to increase range use (thereby also decreasing stocking density within the shed), usually

mentioning providing more shelter. For example, Farmer A said they would put in place "anything to make the range more interesting, so I think more shelters comes into that category".

However, interviewees also identified a number of unpopular management strategies which they had found to be ineffective or to cause other problems. For example, allowing access to range within two weeks of placement on the laying farm was implemented by only three farmers as it was commonly believed to cause an increase in eggs laid outside nest boxes. Farmer K claimed**:** "You really want [the hens] to get used to the nest boxes and if you let them out [on the range] too early they tend to want to lay their eggs outside… Once they start laying outside you'll *never* get them to change… We've tried it before and it was a disaster: we got quite a lot of eggs outside, we were collecting more outside just about as what we were collecting inside". Though all but one farmer said that floor eggs were not a big problem, the fear of creating a problem prevented them from allowing early access to the range, and in some cases to the litter; farmers generally wanted to train the birds to use the nest boxes, so would wait until a high proportion of the flock were laying before allowing them outside. A practical solution to this adoption barrier is the option of allowing the hens to have access to litter or range in the afternoons only, which is a successful strategy that many farmers now adopt. A farmer (RM) not interviewed in this study, reported that "I would never lock the birds up on the slats again at placement. I've got a better, calmer flock by giving access straight away" (Featherwel 2013).

Barriers to the Uptake of Management Strategies

Farmers consistently showed a strong reluctance to adopt management strategies they felt were beyond their capacity to control. Most notable and most frequent reasons included the lack of consistent identifiable causes of IP and there being no guarantee that the adoption of particular management strategies would be reliably effective in controlling IP. "There is no such thing as a blueprint that you've got to follow and you say… you do that every time, you won't get a pecking issue" argued one respondent (Farmer L) with three quarters of the other interviewees making others making similar statements.

345 Lack of control over the weather was also an important barrier for certain management strategies (access to
346 range, litter management) and was mentioned by three quarters of farmers. For example Farmer H reported:
347 "This year because we've had the wettest time ever... we've had trouble with [litter] capping and sticking and
348 I've been throwing sawdust at it... to get [good litter quality] at this time of year, you'll spend all your time
349 throwing litter at it."
350
351 As implied earlier, the genetics of the birds was also specifically mentioned by seven farmers as a major factor
352 influencing IP that lies outside their control. One farmer with an organic flock believed that: "the majority of
353 their breeders are for caged birds, aren't they? They breed them for the cage environment, not free range, not
354 organic" (Farmer I), a view endorsed by scientists (for example Nicol et al, 2013, the LayWel project
355 (www.laywel.eu) who argue for greater emphasis to be placed on selecting genotypes with reduced damaging
356 feather pecking tendencies for use in alternative laying hen housing systems. The rearing environment was
357 also considered by half of respondent farmers in this study to be out of their control. While producers can
358 often select the strain of bird and the rearer, they may still be constrained by limited genotypes, proximity to
359 rearers, historical use and company policy thus in some instances these difficulties faced by producers are
360 indeed hard to overcome.
361
362 Part of the problem is that managing IP on farms requires time in what are perceived as already intense
363 schedules of work. Adopting additional strategies only increases that pressure on time and non-essential tasks
364 become postponed. IP management strategies may be difficult to fit into the established routine, thus be
365 overlooked: "I think we made a conscious effort to get them out earlier than usual [i.e. than previously
366 practised] and we just haven't done it on this occasion. Not by any particular management decision, it's just
367 slipped… fallen back into the old routine" (Farmer F).
368
369 Although all of the farmers stated that financial implications needed to be considered before implementing
370 management strategies (one claiming: "I will look at anything to improve the birds' welfare, but it has to be
371 financially viable to do it", Farmer G), seven actively downplayed the financial implications of instigating

management strategies suggesting they were "pretty cheap" and maintaining they would regain the initial cost by increasing production and reducing problems. This dismissal of economic concern suggests that management strategies had been well designed in terms of cost and cost-effectiveness, and that that intrinsic, rather than extrinsic, factors play a key role in determining their uptake.

Knowledge Transfer

Interviewed farmers thought that good, independent advice about IP was difficult to obtain: one claiming "I wouldn't say it's easy - clear, concise advice is more difficult to come by" (Farmer L) and another that "there's not many independents out there. Whoever's going to tell you something has got a motive for telling you… or something to sell" (Farmer G). Poultry trade magazines were not a popular information source, with only a few farmers mentioning that some magazines were more helpful than others in terms of including relevant articles though subscription fees had become expensive. The internet, as a source of useful information, was only used by 3 farmers with just 4 others recognising others might find it valuable but not themselves: "you can go on the internet if you are that way inclined, but I'm not too good on the internet, I never seem to get what I want off" (Farmer I).

As one might expect, the interviewed farmers sought advice from people they considered knowledgeable about poultry farming, such as veterinarians and feed company representatives. Two thirds of farmers valued the opinions of other egg producers; with six suggesting that organised producer meetings and/or training courses would be beneficial. Nine specifically valued the input and expertise of the University of Bristol research group, Farmer A typifying their views: "the vet has been in the game a very long time and he would probably have some comments to make on [IP], but as I said before, now we know who you are and what you're doing, it's obvious that we'd come to you [the research group]". Though these comments may have been exaggerated since farmers were reporting to the Bristol team, a key finding of the study was that the majority of farmers valued evidence-based knowledge and advice. Over half of the participant farmers said that taking part in the main study had increased their awareness of IP: "I think [the project] has made me more aware of [IP, sooner] than I might have been in the past, because I know now what to look for… like pecking

around the vent area or pulling tail feathers" (Farmer E) while five said they would interpret advice based on their own experience to judge what was most applicable on their farm.

Discussion and Conclusions

With the growing human population it is becoming a priority that farmers adopt the latest techniques to improve sustainability, productivity and animal health and welfare. Indeed this is a priority area for EU funding (http://ec.europa.eu/agriculture/research-innovation/index_en.htm). To be effective, knowledge transfer programmes should, first, aim to both shift perceived norms and attitudes so that issues become recognised, and, second, lead to actions that move towards their resolution. The intervention study (Lambton et al, 2013) which preceded the interviews described here was reported by participating farmers to increase their awareness of IP and their ability to identify it in their flocks, thus theoretically meeting the first premise. In this current study, the exercise in which farmers ranked photographs of flocks with various levels of feather loss nonetheless indicated that there remained a range of perceptions as to what constitutes an acceptable level of IP. Since farmers determine whether they have a problem with IP based on their own normative frame of reference (Jansen et al 2009), consistently high levels of IP can result in such levels being considered normal, and therefore acceptable. This appeared to be the case in half the farmers interviewed in this study, who considered IP to be only a 'moderate' problem. Moreover, as farmers rely largely on their own judgement to identify IP in their own flocks and when to intervene, facilitating an understanding of the many reasons why IP is a problem and embedding awareness of the early signs of IP in their flocks may enable them to identify and take early action against an IP problem.

Providing standardised criteria (e.g. photographs of example flocks) to assist identification of an IP problem, rather than simply relying on their past experiences, may encourage action against IP to be taken sooner. Moreover, they may extend and re-qualify an individual's normative frame of reference. There is evidence from the AssureWel project (www.assurewel.org) that a combination of information regarding the control of IP and the encouragement of farmers to plumage score their own birds has led to significantly decreased levels of mortality and plumage damage (Mullan et al, *in press*). Lambton et al, 2013 also stimulated adoption of

426 strategies which overall achieved the desired outcomes. In this study we have revealed some of the factors
427 underlying the range of uptake between farms.
428 Whether or not individual farmers sought to adopt additional strategies to manage IP was strongly influenced
429 by their perception of the benefits of such strategies and the risks they might pose in terms of time and
430 finance. This is entirely consistent with Coleman et al's 1998 observation that intrinsic factors, in the form of
431 individual attitudes towards relevant behaviours are important in determining whether or not they are
432 adopted. The principal barriers to uptake were a lack of time and lack of control over external factors
433 according to the farmers interviewed. Similarly, dairy farmers identified lack of time and labour availability as
434 principal constraints in treating mastitis (Horseman et al, 2014). Thus, finding management strategies which
435 are easily incorporated into the existing routines, potentially associating a 'non-essential' measure with
436 'essential' maintenance could reduce the perception of adding another task to a full work schedule. There is
437 also scope for innovation to ease the workload of producers such as developing less labour intensive methods
438 of litter management to prevent litter capping during wet weather or of adding objects for hens to peck at.
439 A further indicator that intrinsic factors were important was the fact that farmers in general did not see a
440 financial barrier to adopting additional measures, regarding many of them as being relatively cheap and cost-
441 effective. Personal values such as professional pride and job satisfaction were greater incentives for change
442 than public opinion. However a frequently cited reason for not adopting measures to reduce the risk of IP was
443 the lack of a 'blueprint' of measures proven to be consistently effective, which may be viewed as a
444 combination of intrinsic (perceived helplessness) and extrinsic influences.
445 Extrinsic factors highlighted as providing barriers to change were those like the genetics of the birds or the
446 weather over which farmers had none or very limited control. Farmers were especially resistant to adopting
447 strategies such as early access to litter or range which they perceived to have associated downsides such as
448 mislaid eggs. Here the key to driving change is altering perception and providing evidence that the actual
449 outcome may be different to that perceived. Lambton et al, 2013 and Featherwel provide farmers with
450 evidence that others have acceptable outcomes from not restricting access, and also that a compromise state
451 whereby birds have access in the afternoons, after the main egg-laying period may be achieved, thus shifting
452 perceptions from an 'all or nothing' viewpoint. Shifting attitude to a proactive mindset that finds solutions by

asking ‘how can we achieve the desired outcome?’ and ‘can we do this another way?’ appears to be very important in facilitating change and uptake of interventions and knowledge on farm.

Animal welfare implications

Farmers’ attitudes towards health and welfare problems and related intervention programmes, such as those to reduce injurious pecking (IP) in hens, directly influence the welfare of animals in their care. This study has shown that their perception of an IP problem may rely on their normative frame of reference and has identified intrinsic factors as the principal barriers to change. Thus schemes aimed at improving animal welfare on farm should not only provide independent, evidence-based knowledge but also consider techniques, such as providing photographs, to inform and shift perceived ‘norms’ and to promote farmer-led innovative solutions.

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Table 1. A summary of flock characteristics and implementation of suggested management strategies (MS) for farmers interviewed for this study. Individual farmers are identified by letters A to L and their uptake representing treatment (T) and control (C) flocks from the high (H) [59-78% T, 39-54 C], medium (M) [46-58% T, 36-39% C] and low (L) [18-45% T, 24-35% C] MS-uptake groups. The number used from a potential 46 MS is shown alongside the plumage score, proportion of birds affected by plumage damage (PD) and levels of injurious pecking behaviours (IP) as a mean of values recorded at approximately 20, 30 and 40 weeks by Lambton *et al* (2013) rather than in the subsequent flocks present at the time of the interview.

						Average IP levels				
Farmer code	Uptake	% Uptake of strategies suggested by project team (total no. suggested)	No. of MS employed at the end of the study	Flock type (beak trim status)^	Flock size ('000)	GFP*	SFP**	VP**	Average plumage score***	% birds affected by PD ****
A	CH	N/A (0)	20	FR (BT)	4.6	2.35	0.82	0.03	2.23	79.1
B	CL	N/A (0)	12	FR (BT)	2.8	0.86	2.52	0.07	3.39	77.0
C	CM	N/A (0)	17	FR (BT)	11.8	3.21	1.51	0	0.81	47.6
D	TH	70 (10)	34	FR (BT)	15.4	1.72	0.62	0.15	2.68	67.3
E	TH	70 (10)	28	O (BT)	3.0	0.97	1.5	0.16	2.69	69.6
F	TH	75 (12)	32	FR (BT)	3.7	0.8	0.15	0	1.61	72.2
G	TL	33.3 (6)	26	FR (BT)	7.9	0.83	0.07	0	0.68	59.0
H	TL	20 (5)	16	FR (BT)	13.0	2.33	0.36	0	1.79	67.5
I	TL	18.2 (22)	16	O (BT)	3.9	0.8	1.33	0.07	3.21	80.2
J	TM	50 (6)	21	FR (BT)	12.4	0.04	0	0	0.50	38.6
K	TM	57.1 (7)	29	FR (IB)	4.2	0.06	0	0	0.07	6.8
L	TM	55.6 (9)	28	O (IB)	3.0	0.17	0.03	0	0.66	53.2

^FR = Free range; O = Free range organic; BT = Beak trimmed; IB = Intact beak
*Gentle feather pecking (pecks directed at the tips of the feathers of a conspecific) measured as bouts/bird/hour (series of pecks not separated by any other behaviour or by pause longer than 5s)
**Severe feather pecking (pulling at the feathers of a conspecific)/Vent Pecking (cannibalistic pecking directed at the cloaca) measured as number of individual pecks/bird/hour
***Score ranging from 0 (best) to 16 (worst)
****Average proportion of birds which received a PD score of >0 across three visits

Table 2. Comparative ranking of photographs with varying levels of flock plumage damage between producers and researchers. The flock photographs are ordered according to the 'gold standard' rank order agreed on by the research group (A best plumage condition - I worst plumage condition). Tallies of the rank that each photograph received from eight farmers are presented. The modal ranking given by farmers (dark shading) agrees with the gold standard but the lighter shading indicates variation in the ranks attributed to the flock photographs.

	Tallies of Farmer Rankings								
'Gold Standard'	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
A	**6**	**1**	**1**	0	0	0	0	0	0
B	**2**	**6**	0	0	0	0	0	0	0
C	0	**1**	**6**	**1**	0	0	0	0	0
D	0	0	**1**	**6**	**1**	0	0	0	0
E	0	0	0	**1**	**6**	0	**1**	0	0
F	0	0	0	0	**1**	**5**	**1**	**1**	0
G	0	0	0	0	0	**2**	**5**	**1**	0
H	0	0	0	0	0	**1**	**1**	**6**	0
I	0	0	0	0	0	0	0	0	**8**

Table 3. Ten farmers' ranking of plumage damage showing where each 'drew the line' of acceptable levels of feather cover: in general proactive farmers who adopted more management strategies were less tolerant of feather loss. Nine photographs depicting varying levels of flock plumage damage (PD) were ordered from best to worst (1-9, respectively) by each rater, who then identified the point at which they would consider flock PD to be unacceptable. Flock photographs are lettered according to the 'gold standard' agreed upon by the research group from 'A' (best plumage condition) to 'I' (worst plumage condition).

Farmer Code	**F**	**E**	**D**	**L**	**I**	**G**	**H**	**A**	**C**	**B**
	A		A			A	A	A		
	B	A	B			B	B	B	B	
	C	B	C	A	A	C	C	C	C	
	D	C	D	B	B	D	D	E	A	B
	E	D	E	C	D	E	E	D	D	A
Acceptable	F	E	F	D	C	F	F	G	E	C
Unacceptable	G	F	H	E	F	G	G	F	F	D
	H	G	G	H	G	H	H	H	G	E
	I	H	I	G	E	I	I	I	H	F
		I		F	H				I	G
				I	I					H
										I